TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE RENO, NEVADA SOIL CONSERVATION SERVICE

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TN - PLANT MATERIALS - NV 24

HOW TO CALIBRATE A DRILL

The attached Technical Note was developed by Gary Brackley, State Range Conservationist. Please document this new TN on the Plant Materials Index.

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State Resource Conservationist

Attachment

TECHNICAL NOTE

U.S. DEPARTMENT OF AGRICULTURE RENO, NEVADA SOIL CONSERVATION SERVICE

TN - PLANT MATERIALS NO. 24 NOVEMBER 1993

HOW TO CALIBRATE A DRILL

PRELIMINARY STEPS

1. Check drill to ensure it is in proper working order. Become familiar with drill and its operation. Make sure that seed box is clean and that seed feeder tubes ar not plugged. Perform maintenance inspection.

2. Get an idea from the cooperator about what rates and settings have been previously used. This information can provide a basis for selecting initial drill settings.

3. Always start drill setting adjustments from a wide-open position and close down to position setting desired.

4. For "fluffy" seed that does not flow readily through the drill or to keep mixtures of differing sized seed in constant proportion, rice hulls can be used as a seed diluent. See Nevada Technical Note PM-NO. 1.

5. Depending on method of calibration, several items will be needed:

   a. Seeding rate guide showing species, seeds per pound, planting rates, and seeds per lineal foot.

   b. Canvas or plastic tarp.

   c. Supply of small plastic or paper sacks.

   d. Tape measure (10ft and/or 50ft)

   e. Small scales (grams or ounces).

   f. Heavy duty tape (masking or duct).

   g. Wide-jaw pliers.

   h. Pocket calculator.

   i. Wire stakes.

   j. Heavy duty jack and jack stand.

Prepared by: Gary K. Brackley, State Range Conservationist

METHOD 1 - SEEDS PER FOOT

1. Determine from standard seeding rate guide the number of seeds per linear foot or square foot required to achieve the desired seeding rate.

2. Fill seed box with enough seed to cover all openings on on the floor of the box with a minimum seed depth of 1 inches.

3. Set initial seeding rate on drill and lower the discs or drive wheel to engage seed feed mechanism.

4. Pull drill across a hard surface (not asphalt or gravel as seed is difficult to count, lost in cracks, etc.) or a canvas or plastic tarp.

5. Select a typical section of seeded drill row (or square foot area) and count the seed from at least 10 linear feet (or from 10 square foot sections). Determine the average number of seeds per foot of drill row (or the average number of seeds per square foot). Avoid the first and last parts of drill rows for seed counts. Check that all drill rows (or square foot sections) have similar amounts of seed.

6. Compare the measured number of seeds per foot (or per square foot) with the desired seeding rate. Adjust drill setting up or down and repeat steps 3, 4, and 5 above until desired rate is achieved. A measured rate within ten percent (preferably on the low side) of the desired seeding rate is adequate. Double check results with a second trial using same settings.

7. Set the acreage counter on the drill to "0" (zero) or record the current acreage count on meter prior to start of seeding project. Acreage seeded can be determined by multiplying the distance traveled by the drill width and dividing this total by 43560. An eight foot wide drill covers one acre when 5445 linear feet are traveled. A twelve foot wide drill covers one acre when 3630 lineal feet are traveled.

8. Record the total amount of seed put into the drill box during the course of the seeding.

   NOTE: Allowance should be made for more seed than is required on a straight "acreage to be seeded" basis. To maintain a steady flow rate of seed, at least one inch of seed needs to cover the seed feed openings at the bottom of the seed box. Allow for enough extra seed to seed an additional 1 to 3 acres above the acreage intended for seeding so that sufficient seed remains in drill box to keep seed flow constant during the last portion of the seeding.

METHOD 1 - SEEDS PER FOOT (continued)

9. After seeding several acres, measure (estimate) the the quantity of seed used and divide this total by the number of acres seeded. Compare results to desired seeding rate (pounds/acre) as an additional check of drill calibration.

10. Make a complete record of all drill settings, meter counts, and other data for future use.

METHOD 2 - SEED WEIGHT/DISTANCE

1. On the prepared seedbed or an area similar to the site being seeded, measure and stake off a distance equivalent to 1/100th acre for the width of the drill being used. The distance required for 1/100 acre using an 8 foot wide drill is 54.45 feet. The distance required for 1/100 acre using a 10 foot wide drill is 43.56 feet and distance for a 12 foot wide drill is 36.30 feet.

2. Fill seed box with enough of seed to cover all openings on the floor of the box with a minimum seed depth of 1 inch.

3. Pull drill with drive wheel engaged as during actual seeding operation for about 6 to 10 feet before coming to first stake. Stop drill movement when the seed drop tubes are aligned with the first stake, remove the tubes from seed box or from discs and connect (tape) sacks to tube openings to catch seed while moving to the second stake.

4. Stop drill when the tubes are even with the second stake. Collect seed from all sacks and weigh. The weight of seed (less sack weight) in <u>grams multiplied by 0.22</u> equals the amount of seed sown in pounds per acre. The weight of seed (less sack weight) in <u>ounces divided by 0.16</u> equals the the amount of bulk seed sown in pounds per acre. See below for rationale for these calculations.

5. Compare the measured weight of seed applied (pounds per acre) to the desired seeding rate. Adjust drill setting up or down and repeat steps 2 and 3 above until desired rate is achieved. When a measured rate within ten percent (preferably on the low side) of the desired seeding rate is achieved, double check results with a second trial using same settings.

6. Set the acreage counter on the drill to "0" (zero) or record the current acreage count on meter prior to start of seeding project. Acreage seeded can be determined by multiplying the distance traveled by the drill width and dividing this total by 43560.

7. Record the total amount of seed put into the drill box during the course of the seeding.

   NOTE: Allowance should be made for more seed than is required on a straight "acreage to be seeded" basis. To maintain a steady flow rate of seed, at least one inch of seed needs to cover the seed feed openings at the bottom of the seed box. Allow for enough extra seed to seed an additional 1 to 3 acres above the acreage intended for seeding so that sufficient seed remains in drill box to keep seed flow constant during the last portion of the seeding.

8. After seeding one to several acres, measure (estimate) the quantity of seed used and divide this total by the number of acres seeded. Compare results to desired seeding rate (pounds/acre) as an additional check of drill calibration.

9. Make a complete record of drill settings, meter counts, and other data for future use.

RATIONALE FOR CALCULATIONS USED IN METHOD 2

From APPENDIX: Lbs. per acre of bulk seed planted = $\frac{43560 \text{ X lbs. of seed collected}}{\text{Drill width(ft) X Strip length(ft)}}$

Multiply grams by .00221 to obtain pounds.
Multiply ounces by 0.0625 to obtain pounds.

Given: From METHOD 2, Step 1., drill width X drill length = one hundreth of an acre or 435.60 square feet.

then,

$$\frac{43560 \text{ sq ft X } 0.00221 \text{ (Grams collected)}}{(435.60 \text{ sq ft})} > \frac{96.3 \text{ (Grams collected)}}{435.6}$$

and,

0.22 X (Grams collected) = Lbs per acre

or,

$$\frac{\text{(Grams collected)}}{4.5} = \text{Lbs per acre}$$

OR,

$$\frac{43560 \text{ sq ft X } 0.0625 \text{ (Ounces collected)}}{(435.60 \text{ sq ft})} > \frac{2722.3 \text{ (Ounces collected)}}{435.6}$$

and,

6.25 X (Ounces collected) = Lbs per acre

or,

$$\frac{\text{(Ounces collected)}}{0.16} = \text{Lbs per acre}$$

METHOD 3 - SEED WEIGHT/STATIONARY OR SHOP CALIBRATION

1. Drill calibration can be performed in the shop or without moving drill by jacking up the drive wheel(s) of the drill and rotating it for a set number of revolutions. Some drills have the drive wheel elevated when not in operation and the drill does not have to be raised.

2. Fill seed box with enough seed to cover all openings on the floor of the box with a minimum seed depth of 1 inch.

3. Place a piece of tape (or otherwise mark) on the outer edge of the drive wheel sidewall and orient this mark to a stationary point on the drill body so that each full wheel revolution can be easily assessed. Determine the circumference of the drive wheel. Circumference (C) can be determined by measuring wheel diameter (d) as $C=2\pi(d/2)$. For example, a wheel having a diameter of 29 inches has a circumference (C) of 91.1 inches; $C=2\pi(29/2)>$ $C=2\pi(14.5)>$ $C=(6.283)(14.5)>$ C=91.1". Convert circumference measure (C) to feet, i.e. 91.1"/12" = 7.6 feet. Note: $\pi=3.1415$.

4. Once drive wheel is raised off the ground and the elevated drill is considered safe to work around, remove drill tubes from seed box or from discs and connect (tape or tie) sacks to tube openings to catch seed while turning the drive wheel.

5. Turn drive wheel at least three full revolutions to start seed flow through seed tubes. Remove collection sacks and empty seed back into seed box. Check that all tubes are depositing seed. Reconnect collection sacks to tube openings.

6. Turn the drive wheel ten or more complete revolutions noting exactly how many revolutions are made.

7. Collect seed from all sacks and weigh. Use this measured weight of seed (less sack weight) in one of the formulas shown in step 8 to compute bulk seeding rate. Ensure that all seed tubes are depositing the same amount of seed. Return collected seed to seed box.

METHOD 3 - SEED WEIGHT/STATIONARY OR SHOP CALIBRATION (continued)

8. Use one of the following formulas to compute the bulk seeding rate at the present drill setting:

$$\text{Lbs/ac (bulk seed planted)} = \frac{2723 \times \text{ounces of seed collected}}{\text{Drill width(ft)} \times \text{Strip length(ft)}}$$

$$\text{Lbs/ac (bulk seed planted)} = \frac{96 \times \text{grams of seed collected.}}{\text{Drill width(ft)} \times \text{Strip length(ft)}}$$

$$\text{Lbs/ac (bulk seed planted)} = \frac{43560 \times \text{pounds of seed collected}}{\text{Drill width(ft)} \times \text{Strip length(ft)}}$$

NOTE:

Strip length (ft) = 1.1 [no. of drive wheel revolutions X wheel circumference (ft)]

The factor 1.1 allows for 10 percent wheel slippage in the field not experienced in the shop or when drill is not moving.

EXAMPLE 1:

ASSUME:

83 grams of seed collected when the drive wheel is rotated 12 complete revolutions. Drill width is 10 feet. Wheel circumference is 7.6 feet.

then,

Strip length(ft) = 1.1 (12 revolutions X 7.6 ft circumference)
Strip length(ft) = 1.1 (91.2 feet)
Strip length(ft) = 100.3 feet

and,

$$\text{Lbs/ac} = \frac{96 \times 83 \text{ gm}}{(10\text{ft drill width} \times 100.3 \text{ ft strip length})}.$$

$$\text{Lbs/ac} = \frac{7968}{1003} = 8 \text{ LBS/AC}$$

METHOD 3 - SEED WEIGHT/STATIONARY OR SHOP CALIBRATION (continued)

EXAMPLE 2:

ASSUME:
11 ounces of seed collected when the drive wheel is rotated 12 complete revolutions. Drill width is 10 feet. Wheel circumference is 7.6 feet.

then,

Strip length (ft) = 1.1 (12 revolutions X 7.6 ft circumference)

Strip length (ft) = 100.3 feet

and,

$$\text{Lbs/ac} = \frac{2723 \text{ X } 11 \text{ oz}}{(10\text{ft drill width X } 100.3 \text{ ft strip length})}.$$

$$\text{Lbs/ac} = \frac{29953}{1003} = 30 \text{ LBS/AC}$$

RATIONALE FOR CALCULATIONS USED IN METHOD 3

GIVEN:

Multiply ounces by 0.0625 to obtain pounds. See APPENDIX.

Multiply grams by 0.00221 to obtain pounds. See APPENDIX.

$$\text{Lbs. per acre of bulk seed planted} = \frac{43560 \text{ sq ft X Lbs of seed collected}}{\text{Drill width(ft) X Strip length(ft)}}$$ (See APPENDIX)

thus,

$$\frac{43560 \text{ sq ft X (Grams of seed collected)}0.00221}{\text{Drill width(ft) X Strip length(ft)}} = \text{Lbs/Acre}$$

so that,

$$\frac{96 \text{ X (Grams of seed collected)}}{\text{Drill width(ft) X Strip length(ft)}} = \text{Lbs/Ac}$$

and,

$$\frac{43560 \text{ sq ft X (Ounces of seed collected)}0.0625}{\text{Drill width(ft) X Strip length(ft)}} = \text{Lbs/Acre}$$

so that,

$$\frac{2723 \text{ X (Ounces of seed collected)}}{\text{Drill width(ft) X Strip length(ft)}} = \text{Lbs/Ac}$$

9. Compare the computed bulk seeding rate (pounds per acre) to the desired seeding rate. Adjust drill setting up or down and repeat steps 6 and 7 above until desired rate is achieved. When a measured rate within ten percent (on the low side) of the desired seeding rate is achieved, double check results with a second trial using same settings.

10. Follow procedures described in steps 6 through 9 of METHOD 2 - *SEED WEIGHT/DISTANCE* once actual seeding is undertaken.

METHOD 4 - SEED WEIGHT/STATIONARY OR SHOP CALIBRATION USING CONVERSION TABLE

1. As with Method 3, drill calibration is performed in the shop (or without moving drill) by jacking up the drive wheel(s) of the drill and rotating it for a set number of revolutions.

2. This method is should only be used when it is necessary to quickly estimate drill calibration. Scales used should be accurate to one gram. Calibration formulas are based on a fixed seeded strip area of 192 square feet. Within an area of 192 square feet, the weight of the sample seed collected, in grams, multiplied by the factor 0.5, will result in pounds of seed per acre at a given drill setting. The factor 0.5 is a constant to be used for all drill settings and row spacings. See RATIONALE.

3. Fill seed box with enough seed to cover all openings on the floor of the box with a minimum seed depth of 1 inch.

4. Place a piece of tape (or otherwise mark) on the outer edge of the drive wheel sidewall and orient this mark to a stationary point on the drill body so that each full wheel revolution can be easily assessed. Determine the circumference of the drive wheel. Circumference (C) can be determined by measuring wheel diameter (d) as $C=2\pi(d/2)$. A wheel having a diameter of 29 inches has a circumference of 91.1 inches; $C=2\pi(29/2) > C=2\pi(14.5) > C=(6.283)(14.5) > C=91.1"$. Convert circumference measure (C) to feet, i.e. 91.1"/12" = 7.6 feet. Note: $\pi=3.1415$.

5. Determine the number of drive wheel revolutions (R) needed for the row spacing being used. The variable (R) can be calculated using the following table, where C equals the circumference of the drive wheel in feet and R equals the number of revolutions necessary to cover the required seeded strip length. Refer to Table I "TURNS OF DRIVE WHEEL" column for formula to use in computing R.

EXAMPLE:

ASSUME a. Drill has 6 inch row spacing
b. Circumference (C) of drive wheel is 7.6 ft

and,

96/C = R (from Table I)

then,

96/7.6 = 13

thus,

R = 13

METHOD 4 - SEED WEIGHT/USING CONVERSION TABLE (continued)

TABLE I

ROW SPACING	NUMBER OF SEED TUBES FOR COLLECTING SEED	TURNS OF DRIVE WHEEL
6 inches	4	96/C=R
7 inches	4	82/C=R
8 inches	3	96/C=R
10 inches	3	77/C=R
11 inches	3	70/C=R
12 inches	2	96/C=R
14 inches	2	82/C=R
16 inches	3	48/C=R
18 inches	2	64/C=R
20 inches	2	58/C=R
21 inches	2	55/C=R
22 inches	2	52/C=R
24 inches	2	96/C=R
28 inches	2	82/C=R
30 inches	1	77/C=R
36 inches	1	64/C=R
40 inches	1	58/C=R
42 inches	1	55/C=R
48 inches	1	48/C=R

6. Once the drive wheel is raised off the ground and the elevated drill is considered safe to work around, turn drive wheel at least three full revolutions to start seed flow through seed tubes. Ensure that all seed spouts are feeding well and about the same amount of seed is being deposited from each spout. A tarp can be used to catch seed dropped through the seed tubes.

7. Place a container under the correct number of seed spouts (see Table I) and turn the drive wheel the number of revolutions (R) previously determined.

8. Collect seed from all containers and weigh the sample(s) in grams. Multiply the seed weight (less container weight) by the factor 0.5. The product is the number of pounds per acre bulk seeding rate at the present drill setting. Ensure that each seed tube is depositing about the same amount of seed. Return collected seed to seed box.

9. Compare the computed bulk seeding rate (pounds per acre) to the desired seeding rate. Adjust drill setting up or down and repeat steps 7 and 8 above until desired rate is achieved. When a measured rate within ten percent of the desired seeding rate (preferably on the low side) is achieved, double check results with a second trial using same settings.

10. Follow procedures described in steps 6 through 9 of METHOD 2 - *SEED WEIGHT/DISTANCE* once actual seeding is undertaken.

RATIONALE FOR CALCULATIONS USED IN METHOD 4

GIVEN:

Area of seeded strip = strip length X strip width. (see APPENDIX)

Area of seeded strip = 192 sq ft (for use of Table I)

$$\text{strip width (ft)} = \frac{\text{row spacing (inches) X no. of seed tubes used (from Table I)}}{\text{12 inches}}$$

$$\text{strip length (ft)} = \frac{\text{Area of seeded strip (sq ft)}}{\text{strip width (ft)}}$$

Multiply grams by .00221 to obtain pounds. (see APPENDIX)

$$\text{Lbs. per acre of bulk seed planted} = \frac{\text{43560 sq ft X Lbs. of seed collected}}{\text{Area of seeded strip}}$$ (see APPENDIX)

thus,

1] $$\frac{\text{43560 sq ft X (Grams collected)0.00221}}{\text{192 sq ft}} = \frac{\text{96(Grams collected)}}{\text{192}} = \text{Lbs/Acre}$$

then,

0.501 (Grams collected) = Lbs per acre

2] Assuming a 6 inch row spacing, and a drive wheel diameter of 29 inches, (drive wheel circumference (C) is 91.1 inches, or 7.6 ft.)

then,

$$\text{strip width} = \frac{\text{6 inches X 4 seed spouts used for collection (from Table I)}}{\text{12 inches}}$$

$$\text{strip width} = \frac{\text{24 inches}}{\text{12 inches}} = \text{2 feet}$$

and,

$$\frac{\text{192 sq ft (area of seeded strip)}}{\text{2 ft (width of strip)}} = \text{96 ft (seeded length of strip)}$$

then,

$$\frac{\text{96 ft (strip length)}}{\text{7.6 ft (drive wheel circumference)}} = \text{13 revolutions of drive wheel}$$

EXAMPLE:

Assume that with 13 revolutions of the drive wheel a total of 16 grams of seed is collected in containers placed under the four selected seed spouts,

then,

16 grams X 0.5 = 8 LBS/AC seeding rate.

APPENDIX

CONVERSION FACTORS:

One pound equals 16 ounces

One pound equals 453.6 grams

One ounce equals 28.35 grams

One ounce equals 0.0625 pounds

One gram equals 0.0022046 pounds

Multiply *grams* by 0.0353 to obtain *ounces*.

Multiply *grams* by 0.00221 to obtain *pounds*.

Multiply *ounces* by 28.35 to obtain *grams*.

Multiply *ounces* by 0.0625 to obtain *pounds*.

Circumference(C) = $2\pi r$ or $2\pi(d/2)$, where r = radius of circle and d = diameter of circle

pi (π) = 3.1415

Area (A) *for a rectangle* = length (l) X width (w)

One acre = 43560 square feet

$$\text{Lbs. per acre of bulk seed planted} = \frac{\text{43560 sq ft X Lbs of seed collected}}{\text{Drill width(ft) X Strip length(ft)}}$$

$$\text{Lbs. per acre of bulk seed planted} = \frac{\text{43560 sq ft X Lbs of seed collected}}{\text{Area of seeded strip (ft}^2\text{)}}$$

IMPORTANT CONVERSIONS FOR USE WITH RICE HULLS:

One bushel of barley weighs 48 pounds.

There are 13,600 barley seeds per pound.

$$\frac{\text{Pounds per acre of barley (bulk) seeded}}{\text{48 pounds of barley per bushel}} = \text{Bushels of barley per acre}$$